DOCUMENT RESUME

ED 368 569 SE 054 321

TITLE	Living Classrooms: Learning Guide for Famous & Historic Trees.
INSTITUTION	American Forest Foundation, Washington, DC.
PUB DATE	94
NOTE	56p.
AVAILABLE FROM	American Forests, 1516 P Street, N.W., Washington, DC 20005.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Cultural Context; Ecology; *Environmental Education; Experiential Learning; Forestry; *History Instruction; *Integrated Activities; *Interdisciplinary Approach; Lesson Plans; Science Education; Science Process Skills; Secondary Education; Teaching Guides; *Trees; Worksheets
IDENTIFIERS	Environmental Change; *Hands On Experience

ABSTRACT

This guide provides information to create and care for a Famous and Historic Trees Living Classroom in which students learn American history and culture in the context of environmental change. The booklet contains 10 hands-on activities that emphasize observation, critical thinking, and teamwork. Worksheets and illustrations provide students with tools to plant and care for trees. Activities 9 and 10 enable the students to create a living classroom in which they plant their historic tree. Activities 1-8 teach about the trees and other ecosystem elements of the Living Classroom by having students write tree stories, use trees to show that observing environmental change can help understand history, measure tree size, learn the values of trees for people, introduce the concepts of habitat and interdependence, study the forest's ecosystem, and examine the importance of trees in urban areas. Sections within each lesson contain the concept, behavioral objectives, subjects integrated, skills developed, prerequisites, time and materials needed, background information, procedures to implement the lesson, and possible extensions. Additional information includes a glossary of 38 terms and a tree selection guide that list tree characteristics. (MDH)

CLASSROOMS

LIVING CLASSROOMS

Learning Guide for Famous & Historic Trees

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ACKNOWLEDGMENTS

A forest ecosystem is more than just a collection of trees. It is a complex set of ever-changing relationships between trees, other plants and animals, and their environment. It is through the sum of these relationships that we come to know an ecosystem. Likewise, the creation of innovative education materials cannot be attributed to any one author or team of writers. It is the sum total of efforts of writers, researchers, students, and readers—each making a contribution to the final product.

The Living Classrooms Learning Guide and TreeStories represent such a group effort. The following people and organizations contributed to the design, testing, and review of these materials.

American Forests Staff and Interns

Deborah Gangloff, Vice President for Program Services
Bill Rooney, Vice President for Publications
Jeff Meyer, Director, Famous & Historic Trees program
Susan Corbett, Living Classrooms Coordinator
Ted Field, Director of Education
Michelle Robbins, Managing Editor, Publications
David Dahlquist, Director, America's Historic Forest
Tricia Taylor, Graphic Designer
Joanne DiGiorgio, Graphic Artist
Jeff Pappas, Urban Forests Asssociate
Chris Baraloto, Intern, Education
Aaron Comenetz, Intern, Education
Evan Heim, Intern, Education
Meghan O'Brien, Intern, Education
Kelley Whitton, Intern, Education
Kristen Wilson, Intern, Education

Agencies

U.S. Forest Service, Natural Resource Conservation Education program
Iowa Natural Heritage Foundation, Gerald F. Schnepf, President

Teachers, Schools, and Education Programs

Beth Howard, Director, Lakeside Nature Center, Board of Parks, Recreation, and Boulevards, Kansas City, MO
Phyllis Johnson and Julie Powell, Stilwell Junior High School, West Des Moines, IA
Russell Heyde, Coordinator, Outdoor Education, Anne Arundel Co , MD
Connie Sowards, Robert Jenkins Middle School, Palatka, FL
Carroll Rinker, Indian Creek Elementary School, Kansas City, MO
Pete Alaniz, South San Antonio High School, San Antonio, TX

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Why Study Trees and Forests ?

Make history and science come alive for students of all ages through a Living Classroom of AMERICAN FORESTS' Famous & Historic Trees. This combination of educational materials and Famous & Historic Trees provides a unique opportunity for hands-on activities in history, science, natural resource conservation, and citizenship.

What creates enough oxygen in a day to support a family of four, takes up and releases up to 400 gallons of water every 24 hours, and provides hundreds of dollars worth of air conditioning in a year? Better yet, what can provide all these benefits and still be a tangible link to America's past? Answer: Mature trees, like the parent trees of Famous & Historic Trees. Famous & Historic Trees are direct descendents of trees associated with notable people and significant events in history.

Using the planting and care of trees as a focal point, AMERICAN FORESTS' Living Classroom activities lead students along new paths of learning in science, literature, geography, art, and history.

Why tie trees and history together? Because the environment has shaped our history, and we have shaped the environment through our history. In fact, our heritage is etched into the landscape around us. Trees—the oldest living things on Earth—stand as witnesses to change. Some species, such as the bristlecone pine, can live to be 6,000 years old—starting their lives near the beginning of recorded history.

Every human civilization has been founded, in part, on the resources of its forests and trees. Forests supplied land, fuel, and wood for building, and fired the imaginations of artists and storytellers. The English sailed west across the North Atlantic to find plentiful and secure timber supplies for their fleets. At that time, more than two-thirds of the American continent was covered by forests. Britain created policies that protected tall trees for their fleets, while settlers cut forests to make way for farms, towns, and cities. Trees were memorialized in song and poetry; even early American flags used trees as symbols. During the American Revolution, Patriots rallied around "Liberty" trees in the cities and towns.

We study forests and trees to better understand our history and our role as modern forest stewards. We better understand and appreciate George Washington when we realize that he was a tree lover who recorded his plantings as meticulously as he recorded any battle or the debates of the Continental Congress. We can imagine much more clearly the fight for human rights when we visualize Abraham Lincoln speaking to people in a grove of oaks, or Martin Luther King Jr. speaking in the shade of a water oak in Selma, Alabama. The energy and genius of American inventors comes alive when we are able to study the impact of Henry Ford, George Washington Carver, or Thomas Edison in the company of trees that were meaningful to them.

The study of trees and forests reveals much about the people we have become. The reverence Native Americans have for nature, the grit and determination of lumberjacks and pioneers, the ingenuity of slaves who used forests for refuge and worship, and the vision of early conservationists are all part of what we are today. Every great American city has at its heart a core of wood. Forests provided materials for building, for transportation, for food and fuel. Trees provide direct, tangible links to our past.

The Famous & Historic Tree collection is a window to our past that offers important lessons for our future. Using historic trees to teach and learn brings history and science alive. Planning, planting, and caring for a grove of trees allows students to learn essential skills and develop an appreciation for the world they will inherit. Taking responsibility for these repositories of history is an important step in becoming a responsible citizen. By creating and caring for a Famous & Historic Trees Living Classroom, your students are participating in America's proud tradition of finding and defining itself in the trees and forests around us.

A Note to the Teacher

Using This Guide To Create a Living Classroom

This Learning Guide and the Famous & Historic Trees and TreeStories provide you with tools and information to teach about American history and culture in the context of environmental change. These materials can be used to teach the most important lesson of all: We all live in the natural world and our actions influence the environment, just as the environment influences our actions. Understanding this is fast becoming a prerequisite for responsible citizenship. Students need to know that their knowledge, actions, and leadership can make a difference. Planting and caring for a Famous & Historic Tree reinforces students' ties to our nation's history while making a positive environmental impact.

Each hands-on activity emphasizes observation, critical thinking, and teamwork. The activities are designed as models that allow teachers maximum flexibility to use the TreeStories and to teach across the curriculum.

Worksheets and **Illustrations** are clearly marked and can be used as blackline masters to copy for student use. Worksheets and illustrations provide students with the tools to plant and care for trees. The Learning Guide also contains a USDA Planting Zone Map and **Tree Selection Guide**. The map shows where different tree species can be planted in the United States. The matrix provides basic information such as tree height, foliage, and fruit for each of the Famous & Historic Tree species.

Taken as a whole the Learning Guide provides all the basic information to plant and care for a Living Classroom that can be used to teach basic environmental concepts. When combined with the TreeStories, the materials become powerful instructional tools for teaching about American history, trees, forest ecosystems, and environmental change.

The Learning Guide begins with a preparatory activity called "Warm-up with Tree-Talks." Use "Warm-up with Tree-Talks" to start students observing the natural world around them. Basic definitions of forest regions are provided to help the teacher orient students to forests. This is especially important for students in urban areas, where people sometimes feel that forests are far away places. However, the urban forest is as much a forest as any other forest ecosystem. Urban forests have street trees, park trees, birds, and animals, such as squirrels, that makeup the urban natural world. Urban trees are as important to urban ecosystems as are people, streets, and buildings.

It is important to plant your Famous & Historic Trees as soon as possible after you receive them. If they are ready for planting, you should start your Living Classroom learning experience with Activity 9, Create a Living Classroom, and Activity 10, Planting Your Historic Trees. After designing and planting your Living Classroom, use Activities 1-8 to teach about the trees and other ecosystem elements of your Living Classroom.

Activity 1 -- Outline for a TreeStory

This ongoing activity forms the core curriculum of your Living Classroom. Students will use the TreeStories to develop their own tree stories. As they work through the remaining activities of the Living Classroom Learning Guide, they will be integrating basic concepts of environmental science into their work. Storylines can emphasize science, civics, local history, and art, and can change from year to year. Use this activity to plan future Famous & Historic Tree plantings in your Living Classroom. Over time, the Living Classroom will tell a unique story about the school, its students, and the community, as well as about American history.

Activity 2 — Time Travel Through a Tree

This activity uses trees to show that observing environmental change can help us understand human history. Students will use the rings of a tree to learn how trees are structured and how they grow. They also will use the tree rings to create a chronology of human events.

Activity 3 — Stake a Claim on a Tree

By measuring tree size and comparing trees, students will begin to make their own natural histories to complement human history.

Activity 4 — What's a Tree Worth?

Students will learn that trees have many different values for people. They also will learn that people's reasons for valuing trees change over time.

Activity 5 — Nurture a Habitat

This activity introduces the concept of a habitat; students will learn that habitats are defined in terms of species-specific needs. The Living Classroom can be a habitat for some species.

Activity 6 — The Web of Life

In this activity, students will learn the important concept of interdependence.

Activity 7 — Do-It-Yourself Forest

Students will learn that forests are ecosystems. They'll also learn that people are part of the forest ecosystem and that human action can influence how it evolves.

Activity 8 — The Cool Electric Forest

This activity uses the impact that the urban forest has on the "urban heat island" as an example of the importance of trees in city life.

Activity 9 — Create a Living Classroom

Students will learn how people can shape ecosystems by planning Famous & Historic tree plantings.

Activity 10 — Planting Your Historic Trees

Through this activity students will learn that they can make a positive impact on the environment by planting trees.

What Are Forests?

People everywhere depend on healthy forests. Even city-dwellers depend on trees and forests for clean air and water, for keeping soil from eroding, and for providing wood to make furniture and buildings. Many people around the world rely on forests for fuel to heat their homes and cook their food. Indeed, animal life is possible because of forests.

Forests

Forests are complex ecosystems in which plants and animals form relationships with one another and with their environment. Trees, the dominant species in forest ecosystems, are the Earth's great air conditioners. They rid the air of excess carbon dioxide and replenish oxygen. Forests also filter water, trapping organic and inorganic particles in their roots to make soil. Forests help moderate climate and determine climatic patterns throughout the world.

It is important to understand that in both rural and urban areas, trees form communities of plants, animals, and insects. In rural areas forests shape the landscape, influencing how animals and other plants live. In urban and agricultural areas, it is people who shape the landscape and influence how other living things—including trees—survive.

Trees

There are two major types of trees found in North America. They are coniferous and deciduous trees. Conifers are sometimes known as evergreen trees because they have leaves throughout the year. For the most part, their leaves are in the shape of needles. Deciduous trees are sometimes called broadleaves because their leaves are flat and appear two dimensional. Deciduous trees shed their leaves during the fall, leaving their branches bare throughout the winter.

Forest Types

There are six major forest types around the world; five are found in the United States. Only the tropical rainforest lies outside of the U.S.

Cool Coniferous Forests are dominated by conifers and are found in the higher latitudes, including Alaska and much of northern Canada. They also are found at higher altitudes in other regions such as the mountains of New England. Cool Coniferous Forests are also known as boreal forests. Trees found there include several species of spruce, pine, fir, hemlock, and northern white cedar. Some deciduous trees such as red oak, birch, beech, and sugar maple can also be found there.

Temperate Mixed Forests are found in temperate regions that have distinct seasons such as hot humid summers and cold, snowy winters. These forests have both coniferous and deciduous trees. In the United States, Temperate Mixed Forests are divided into three zones:

- Eastern Deciduous Forests, which range from the Atlantic seaboard to the Midwest, include oak, elm, beech, ash, and maple, as well as some coniferous trees—pine, fir, spruce, and hemlock.
- Rocky Mountain Coniferous Forests, located in the mountainous western U.S. from Canada to Mexico, contain ponderosa pine, Engelmann spruce, white fir, and larch.
- Pacific Moist Coniferous Forests, found on the west coast of the U.S. and Canada from Alaska to northern California, include redwood, sequoia, Douglas-fir, Sitka spruce, and western redcedar. Some of the areas along the Pacific Northwest coast are so wet that they become temperate rainforests.

Dry Forests are found in arid and semi-arid regions that have distinct wet and dry seasons but little total rainfall. In the United States, they are found in southern California, southern Arizona, New Mexico, and parts of Texas. In the United States, these forests typically contain mesquite and live oak.

Warm Temperate Moist Forests have mild temperatures with very few days below freezing and abundant rainfall. They are found in the southeastern states from Maryland to eastern Texas. The trees best suited to this climate include longleaf pine, slash pine, shortleaf pine, loblolly pine, and baldcypress, as well as many different species of deciduous trees.

Tropical Moist Deciduous Forests have distinct rainy and dry seasons, but no cold weather. The dominant tree species are deciduous. These forests are located on the southern tip of Florida, in Hawaii, and in Puerto Rico. They are characterized by gumbo-limbo, mangrove, wild mahogany, and poisonwood trees.

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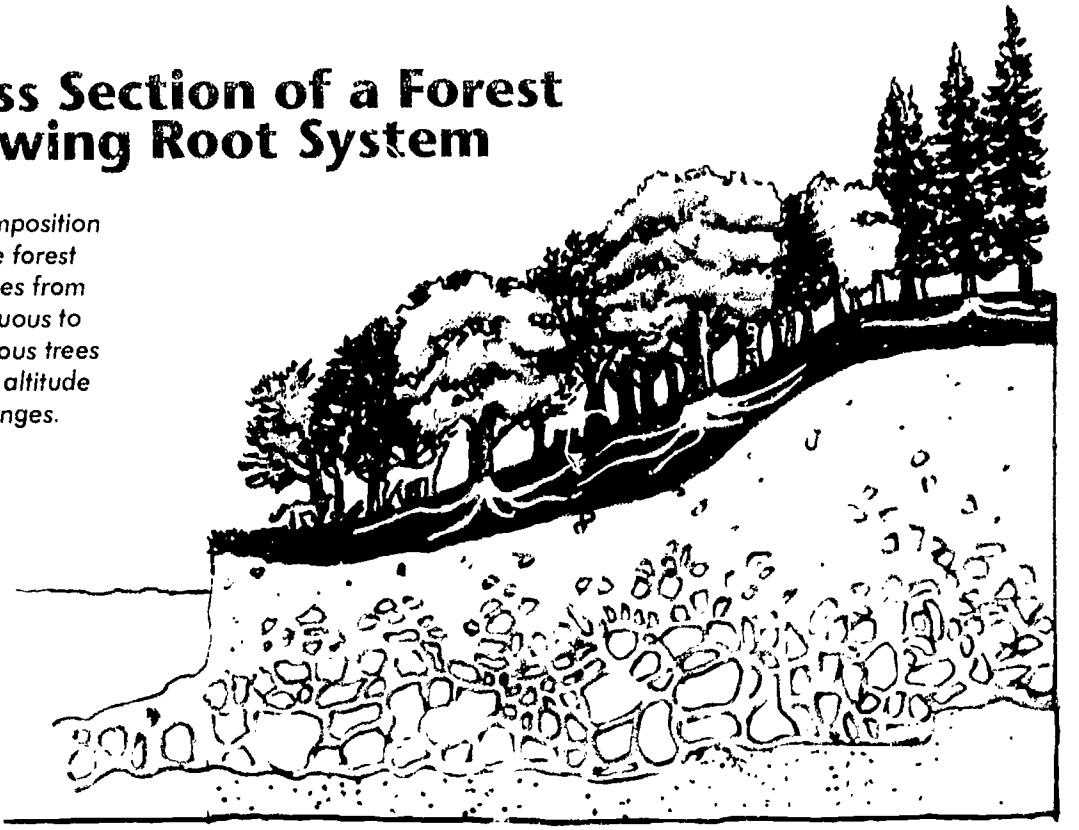
Urban Forests are a unique "type" that cuts across all other forest classifications. Urban forests may well have begun as one of the six forest types. But because of urban heat and pollution, and people's preferences for certain types of trees, many of the species native to a particular forest region can no longer survive in that location if it becomes an urban area. In the urban forest, humans are the predominant species and determine the quantity and type of tree species. Tree health in urban areas is also affected by soil compaction, pollution, and the "heat island" effect. Trees such as locust, gum, cypress, and certain oaks are often seen in urban areas because they are suited to compacted soils and hotter, drier conditions.

Cross Section of a Forest Showing Root System

The composition of the forest changes from deciduous to coniferous trees as the altitude changes.



Warm-up with a Tree Talk

Teachers' Note: Use these activities to introduce your students to trees and forests. If your students are not used to outdoor learning, or find outdoor activities uncomfortable, use the Tree Talk to get them used to outdoor learning and touching trees, plants, and soil. You can modify these exercises by bringing leaves, soil, or small trees (or parts of trees) into the classroom for them to study.

A. Tree Talk

Use the following in an oral or written quiz format to generate an initial discussion of forests and trees. Ask your students to:

1. Name a tree they have seen or that is familiar to them.
2. Name a tree that sheds its leaves in the fall, appears to be dead through the winter, and then looks alive again in the spring.
3. Name a tree that looks alive all year long.
4. Name a tree with needles.

B. Tree Terms

The Glossary provides a starting point for key vocabulary words. Students may conduct a word search, create a cross-word puzzle, or provide an illustration of one or several terms. Examples of key words are:

cambium	heartwood	roots	silviculture	xylem
canopy	phloem	sapwood	trunk	

C. Tree Memory

Have students write a paragraph about a tree in their neighborhood, or near their school, and have them include answers to the questions below. (If there are no trees near their home or school, have them explain why.)

- How tall is the tree?
- How big around is the tree at its base? Halfway up the trunk? At the top?
- What is the shape of the tree?
- How far do its branches spread?
- What are the size and shape of its leaves?
- What animals live in and near the tree?
- What values does the tree provide to people?
- What kinds of seeds or flowers does the tree have?

D. Tree Picture

Have students draw a tree from their neighborhood or schoolyard and list activities or reasons that people might gather around the tree. Have the students include other animals around the tree.

ACTIVITY 1
Outline for a TreeStory

Concept Trees are tangible links to the past, and they can be used to teach about history, social studies, language arts, and science.

Objective Students will learn to use trees to tell stories about themselves, others, and the world around them.

Subjects Social studies, history, literature, life sciences.

Skills Observation, analysis, writing, oral presentation, teamwork.

Prerequisites None.

Time From one class period to a full-term. Can be structured as an ongoing activity.

Materials Student journal • Pens • Paper • TreeStories

Background Introduce learning about trees, history, and people by using myths, legends, poems, and stories, such as *The Song of the Trees* by Joyce Kilmer, to portray different peoples and cultures. Trees and forests also provide the settings for stories such as Kenneth Grahame's *Wind in the Willows* and J.R. Tolkien's *The Lord of the Ring*.

Some examples include:

The Epic of Gilgamesh, the stories of Paul Bunyan, and the travels of Johnny Appleseed show how different peoples perceived trees and forests at different times in history. Gilgamesh was the ruler of Uruk, a city in southern Mesopotamia, about 2700 BC. He wanted to make a name for himself by building up his city. The wood he needed to do this was in a nearby cedar forest that was protected by a fierce demi-god named Humbaba. Humbaba had been appointed to guard the forest by Enlil, the principal Sumarian god. Gilgamesh armed his men with axes and took them into the forest. They opened the forest to civilization by defeating Humbaba in a fierce battle, and the forest was cut down to build Gilgamesh's city.

Paul Bunyan was a giant lumberjack who could bring down whole groves of trees with a single swing of his ax. He was born in Maine, where he first began to cut down forests. As they traveled west in search of timber to cut, lumberjacks told stories about their hero and his faithful blue ox, Babe, and the legend of Paul Bunyan

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- Perlin, John. 1989. *A Forest Journey: The Role of Wood in the Development of Civilization.* Cambridge, MA: Harvard University Press.
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- Giono, Jean. 1985. *The Man Who Planted Trees.* Chelsea, VT: Chelsea Green Publishing Co.

spread to Wisconsin, Michigan, and Minnesota.

Johnny Appleseed, unlike Gilgamesh and Paul Bunyan, was a real person who traveled west from upstate New York in the mid-19th century. Unlike the others, this American folk hero's story was about tree planting: All along his journey, he planted apple seeds from which grew apple trees and orchards.

Jean Giono's *The Man Who Planted Trees* is the story of Elzeard Bouffier, who single-handedly replanted trees in the foothills of the French Alps. Giono's story is about the need for character and selfless persistence when restoring forests.

In West Africa, people tell a story about the Baobab tree, which has a large trunk and wild and unruly limbs and branches. This story is used to warn young people about the dangers of vanity. When the Baobab was very young, it was a beautiful tree, with graceful limbs that formed a magnificent crown. It was the envy of all the other trees. The Baobab prided itself on its good looks and went so far as to say that it was the most beautiful thing in the world. This vanity and snobbishness angered God. "Nothing should be so self-centered," God cried. As punishment, God ripped the Baobab out of the ground, and put it back upside down. Now the beautiful crown was underground, where no one could see it, and the ugly tangled roots waved in the air for all to see and ridicule.

Henry David Thoreau and Aldo Leopold are famous for their journals in which they recorded their observations about nature. Leopold, in *A Sand County Almanac*, and Thoreau, in *Walden*, gave detailed descriptions of plants, animals, and changing seasons.

Procedure

1. Introduce TreeStories. Each student should choose a TreeStory to work with.

2. Have students develop a list of questions and answers about their tree. For example:
   - Why is this specific tree named after this specific person or event? Where is the parent tree? How did this tree come to be associated with the event or person?
   - What is the average life span of this species? How old is the Famous & Historic Tree now?
   - How many trees of this species are there in your neighborhood?
   - How is this species used for energy conservation, soil conservation, construction, commercial products, or fuel?
   - What pests and insects disturb this species?
   - Is this species native (indigenous) to the area? If not, to which regions is this tree native?

3. Working from their questions, either individually or in cooperative learning groups, have students begin to study trees and forests to develop activities to teach others about trees and history. Some suggested activities:
   A. Have students sit with their journals by a Famous & Historic Tree in the Living Classroom. Have them write down what they imagine happened around its parent tree to make it a Famous & Historic Tree.
   B. Write a description of the tree—what are its physical characteristics?
   C. Over time and at specific intervals (once a week, once a month) have students record their observations about the tree—its growth; changes from season to season; unique and unusual marks; its colors, shapes, and smells; and so on. Students can mark each observation date and the height of the tree on the tree tube.
   D. Tree Pals (like pen pals)—Find out which other schools have Famous & Historic Trees. Have students write students in the other schools to ask them questions about their trees.
   E. Have students research the life and times of the historic person or event with which the tree is associated.
   F. Have students create either a single one-act play or several plays that tell the story of the person or the event represented by your tree. Present the plays for other grades or classes.

Discussion

As students develop their TreeStories, have them share their stories with one another, comparing and contrasting what each is observing about the tree. Discuss why some TreeStories emphasize different events, and why others seem similar.

Extensions

Have students illustrate their TreeStories through posters or as comic books. If the school has a well-equipped media center, have students produce a TreeVideo for broadcast over a school or neighborhood cable network.

Have students produce a TreePaper with TreeStories and local history for circulation in their community. Are there any trees of local or state historical value near the community? Research local histories and interview older people to find out.

Have students create a TreeCalender based on 12 months of observations. Include important dates that pertain to the famous person or historic event.

ACTIVITY 2

Time Travel Through a Tree

Concept

Trees and the environment are used to understand human history.

Objectives

Students will learn to use natural events to document changes in human development.

Students will learn what a tree is.

Subjects

Botany, tree physiology, geometry, social history, natural history.

Skills

Observation, analysis, hypothesis, evaluation, mapping, and oral and written communication.

Prerequisites

None.

Time

Two 40-minute class periods (minimum).

Materials

Illustrations of roots, leaves, cross section of a temperate tree trunk, and trees (pages 14-17) to use as handouts.

If you can, obtain a "silvi-cookie." This is a cross section or core sample from a tree. A tree (or limb) cross section usually can be obtained from a local tree-trimming service, forest industry, or utility company that is clearing or trimming trees from power or telephone lines. Other resources for obtaining a silvi-cookie include your state or county Departments of Natural Resources or Forestry, or the local Extension Service office.

Background

A tree is a woody perennial plant. A tree usually has a single stem or trunk from which limbs or branches sprout some distance from the ground. Limbs and branches carry a spreading crown of leaves. A tree also is a living thing with its own natural life cycle through which it germinates, grows, and dies.

People record events through stories, monuments, and written accounts. History helps us to learn about the present—where we are today—by looking at what happened in the past. (Give an example of relevant historical/current perspective that is appropriate for the age, location and concerns of students.) Trees also keep track of history. As they grow, trees record weather, physical events, and the passage of time.

To interpret a particular tree's record of history, we must first look at how trees grow. A tree records "memories" within the structure of its trunk. Everything that impacts the tree throughout its life—from insects, wounds, and disease to floods and fire—leaves

its mark. Sometimes the impact will result in rapid or slower growth, which is shown by different ring sizes in the cross section of a tree.

Trees growing in regions where there are marked seasonal changes record their growth in rings. In these regions, trees have distinct periods of growth and dormancy. A growth ring usually appears each year in dry or cold weather; the outer rings are the most recent. A narrow growth ring indicates a season in which the tree grew very little—during a drought, for example. A wider growth ring indicates a season in which the tree grew a great deal. Trees growing in regions with no distinct seasonal change, such as tropical rainforests, do not have annual growth rings because their growth is fairly constant.

Procedure

For the class as a whole:

1. Obtain a silvi-cookie, or cross section of a tree, or use the handout illustration of a cross section.

2. Measure the diameter and circumference of the cross section. Discuss how the tree's circumference relates to its age and growing conditions. Calculate the surface area of the cross-section ($A=Pr^2$).

3. Identify similarities and differences in sizes of and space between tree rings. Discuss with students possible reasons for these differences.

4. Students can *estimate* the age of a tree with the following formula. Age = DBH(inches) X 1.75 + 8.30. DBH means diameter of the trunk at breast height (or 4½ feet.) Remind students that the figure they arrive at is only an estimate.

For cooperative learning groups:

1. Have each group discuss the cross section of the tree:
   - What do widely spaced growth rings mean for this tree?
   - What natural events might have affected the tree's growth?
   - What human factors might have affected the tree's growth?

2. Have students create a timeline for the life of the tree. Start with an estimate of when the tree germinated (when it began to grow from a seed), and continue until the current date. Charting the time in five-year increments may be sufficient if the tree is old enough to have many growth rings close together.

3. Have students include what they consider memorable events along the timeline:
   - Birth dates of self, family and friends.
   - Year they began school.
   - Year the town or community was settled.
   - Year their state entered the union.
   - Year of the first presidential election they remember.
   - Year family immigrated to the U.S. or other personal and family events.

4. Have students choose a Famous & Historic Tree and chart events associated with that tree on a silvi-cookie timeline.

5. Have each cooperative learning group write a TreeStory based on their timelines to be presented to the class.

Discussion

Have students discuss their different TreeStories. Why are some TreeStories the same, while others are different? Why do people have different perceptions of history?

Extensions

Have students find old photographs of their school, neighborhood, or city. Compare the scenes with what they see now. Are there more or fewer trees now? Are the trees larger or smaller than they were in the past? What has changed? What do the students think changed the urban forest around them?

Have students locate photographs or illustrations from 25, 50, 100, and 150 years ago. How has the local environment changed? Have students imagine how the same scene might change in the next 25, 50, or 100 years.

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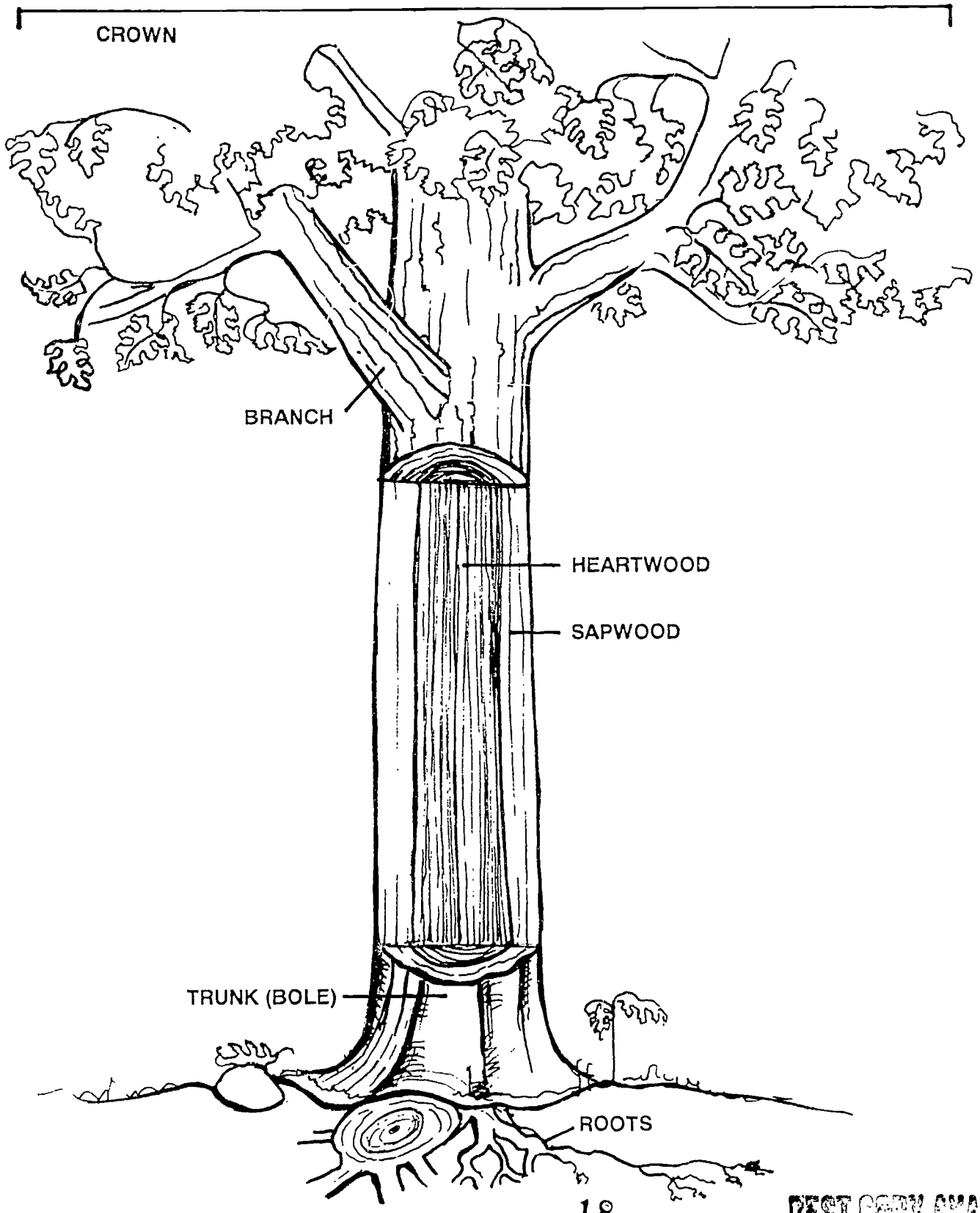
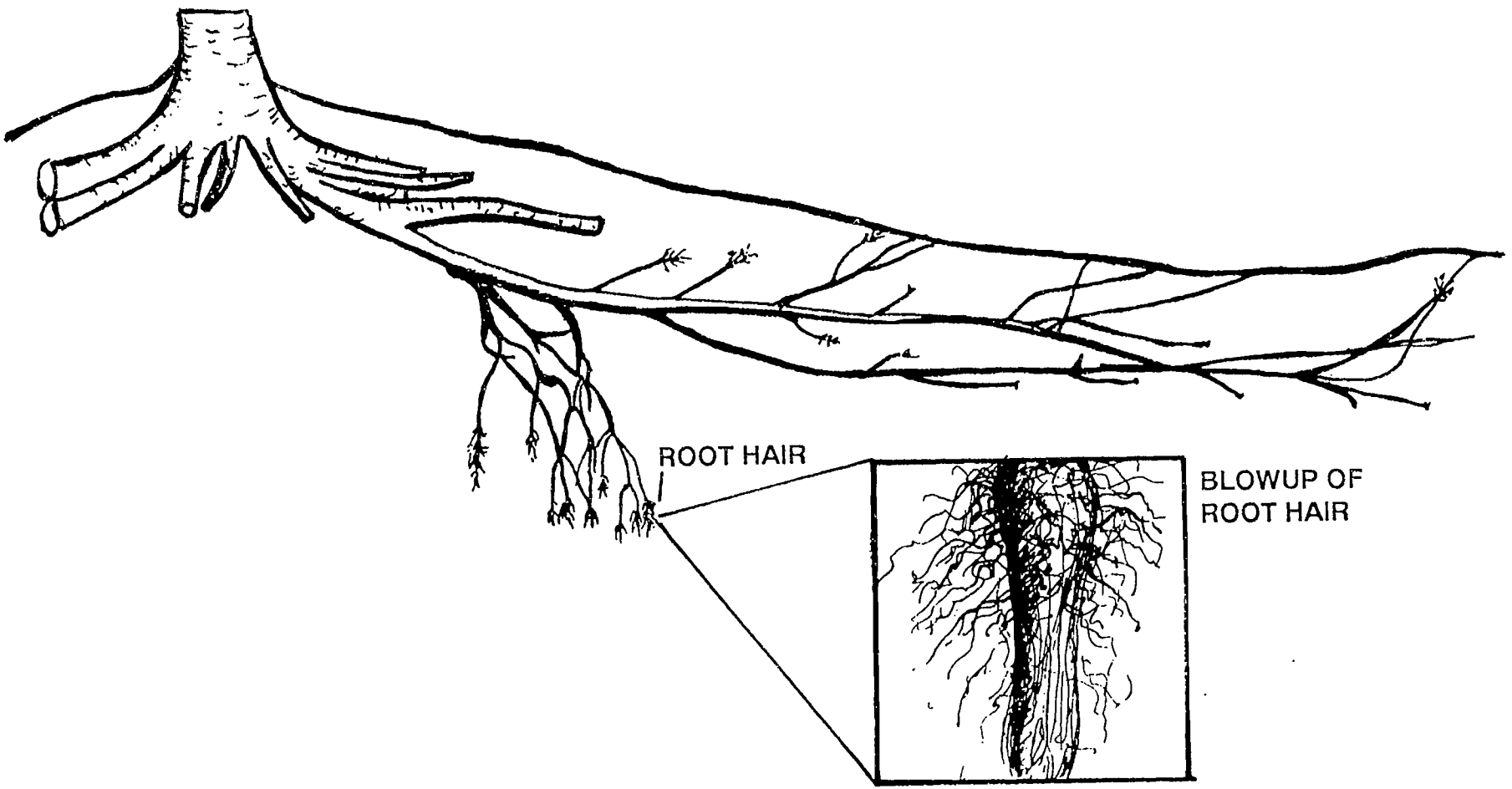
Tree Parts

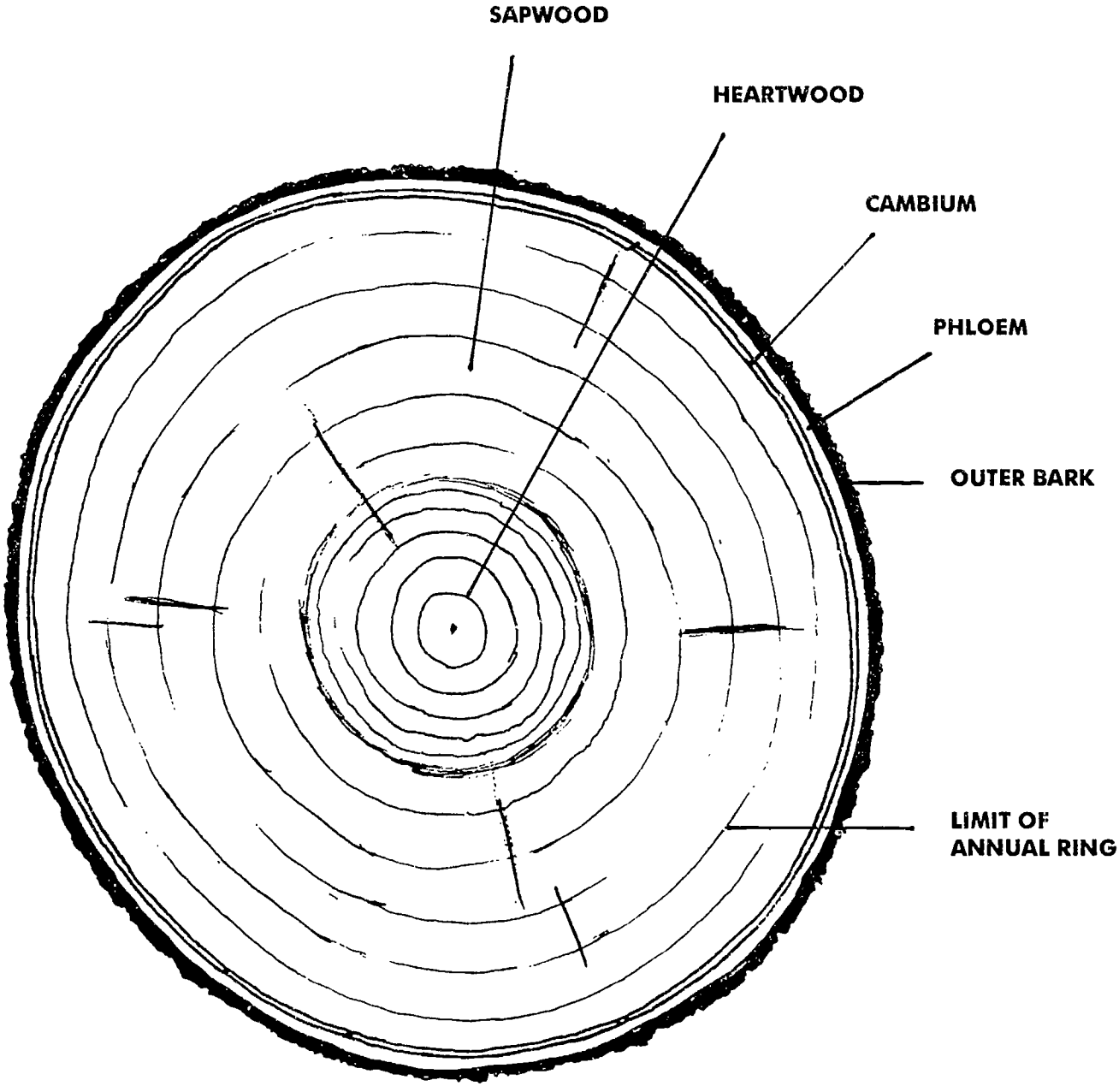


Root System

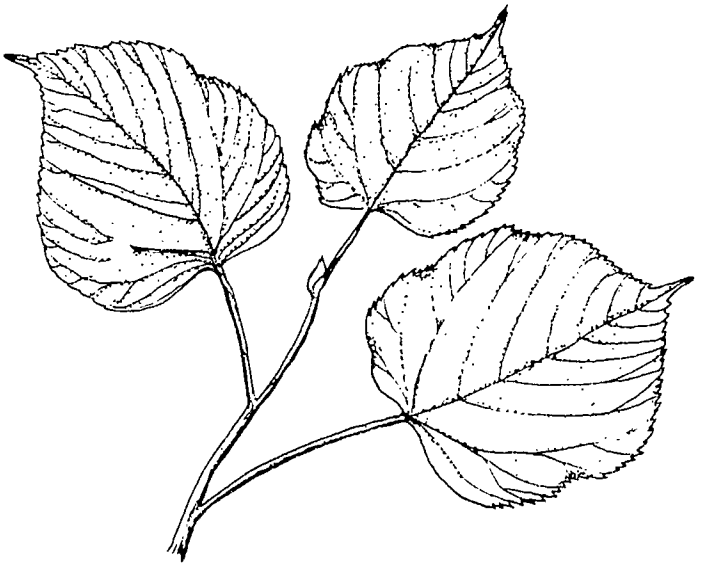


Silvi-cookie

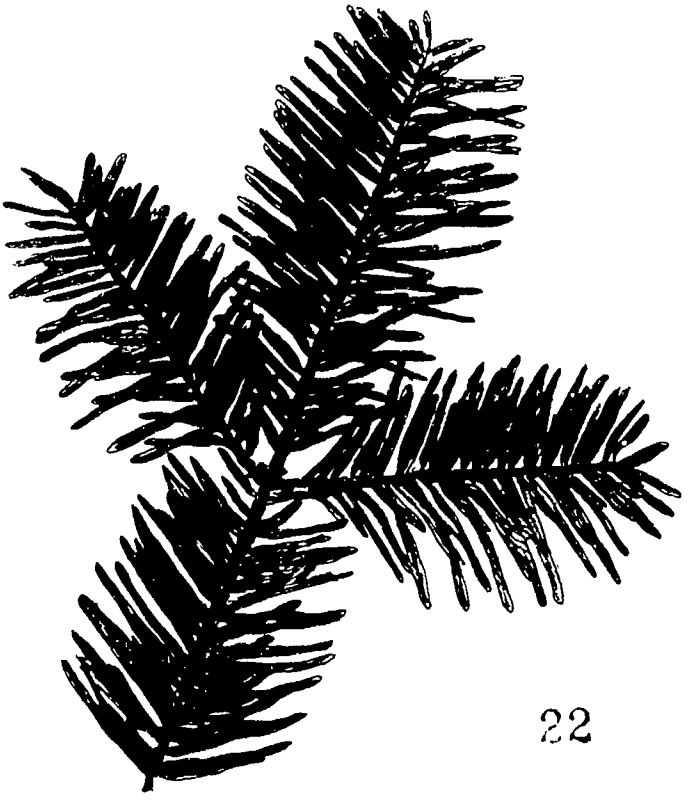
Cross section of a tree trunk showing age rings



Broadleaf (linden)



Evergreen (grand fir)



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ACTIVITY 3

Stake a Claim on a Tree

Concept

Different species of trees need different nutrients and amounts of water and sunlight to survive. Within species, different trees are unique individuals whose growth and life cycle are influenced by available nutrients, water, and sunlight.

Objective

Students will learn to observe trees as unique individuals.
Students will learn to measure tree size.
Students will learn how seasonal changes affect trees.

Subjects

Climatology, ecology, local natural history.

Skills

Record-keeping, comparison, analysis, evaluation, independent study.

Prerequisites

None.

Time

20 to 30 minutes, once a week.

Materials

Paper • "How Big Is Your Tree?" worksheet
Pens/pencils • Notebooks or journals

Background

The natural environment changes over time. Rainfall, soil conditions, temperature, length of day, and other physical factors affect a tree from year to year. These climatic and physical changes determine when a deciduous tree sheds its leaves in autumn, how long it appears to be dormant in the winter, and when it begins to bud and grow flowers and leaves in spring. Evergreen trees give the appearance of never changing (except in size), yet these trees also drop and replace leaves.

The health of a tree can be determined with a visual inspection. Leaf discoloration, insect damage, and brittle branches may mean that the tree is not healthy.

Procedure

1. Have students "adopt" a tree individually or as a class, and explain why they chose that particular tree. Ask students such questions as:

- Do you have a favorite tree? If you do, why is it your favorite?
- Do you sit in the shade of your favorite tree? Do you climb it?
- Where is your tree?
- If you don't have a favorite tree, why not?
- Do you think trees are important? Why or why not?
- What special significance do trees have for you?

- How do people say "tree" and "forest" in other languages?

2. Have students measure their adopted tree. (Use the "How Big Is Your Tree?" worksheet.) Students can compare the total number of points for their tree to the champion of their tree's species in AMERICAN FORESTS' National Register of Big Trees.

3. Ask students to create a journal or a photojournal to record observations of their adopted tree. This journal will allow students to keep track of events in the tree's life. Students may begin by recording answers to such questions as:
   - How tall is the tree?
   - How big around is it? At the base of the trunk? At the top? A single branch?
   - What is the shape of the tree?
   - What size and shape are the leaves?
   - Are there flowers? Describe them.
   - Does the tree bear fruit? Describe it.
   - What colors are the tree, its bark, and its leaves?
   - What animals live in and around the tree?
   - Are there other plants or living things on the tree?
   - Is the tree healthy? How can you tell?
   - Do people use this tree? How?

4. Ask students to observe the adopted tree during each season and record their observations in their journals. Have the students explain the effect of seasonal change on the tree—how and why the tree changes as the seasons change. Questions students might answer:
   - Autumn: How has the tree changed? What color are the leaves? Does the tree still have leaves? Are there new visitors to the tree?
   - Winter: What changes do you notice? Are there any new visitors to the tree?
   - Spring: Do you see buds on the tree's small leaves? Are there flowers on the tree? Are there any new visitors to the tree?
   - Summer: Is the tree bearing fruit or nuts? How are the leaves changing?

Extension

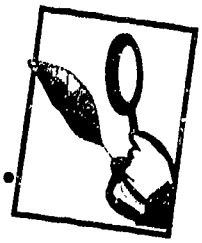
1. Ask the students to draw a picture of their tree and collect a leaf from it. Have students press the leaf to preserve it. To make a leaf press:
   - Place several sheets of newspaper on top of a wooden board.
   - Place leaves on the newspaper, alternating layers of newspaper and leaves.

- Cover the last leaf with several sheets of newspaper and place a second board on top.
- Place books, bricks, or other heavy objects on top of your leaf press. Allow the leaves to dry in the press for several days.
- Carefully remove the leaves from the press and glue each leaf to a piece of paper. Needle-like leaves (particularly short ones) are difficult to press, and often crumble.
- On each sheet of paper, write the tree's name and the location and date it was collected.
- Cover each sheet with clear contact paper.
- Collect the sheets in a ring binder. Now you have a classroom leaf guide!

2. Pass tree observations on to the next class; over the years students will create a history of their tree. If students pick a recently planted tree or a young tree, its history may begin with the first class to observe it. Students will be creating a natural history of the area. A journal containing photos and drawings, along with information about rainfall, temperature and other factors, will create a natural history of the area as told through their tree.

WORKSHEET

How Big Is Your Tree?



This measuring guide is used by AMERICAN FORESTS' Big Trees program. In this program, people from across the country measure trees to find the largest of their species. These "champions" are then included in AMERICAN FORESTS' National Register of Big Trees.

Materials

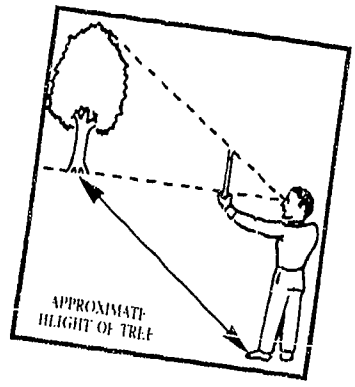
Tape measure (or string with lengths marked off) • Pencils • Living Classrooms Video

Trunk

Measure the tree's "waist," or circumference, at 4½ feet above the ground.

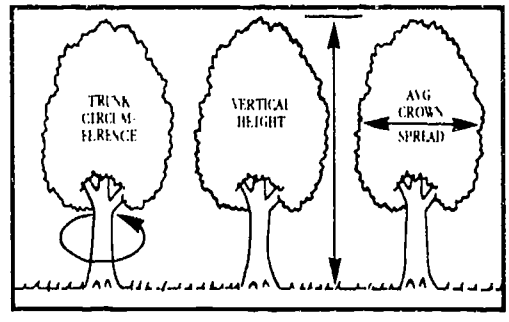
Height

1. Hold the pointed end of a pencil one pencil-length from your eye; close one eye and slowly (and carefully) walk backward from the trunk of the tree.
2. Stop moving backward when the pencil appears to be even with the top of the tree.
3. Ask a classmate to measure the distance between you and the tree's trunk. This is roughly the height of the tree. This method of estimating a tree's height is called triangulation (based on the laws of geometry).



Crown

1. Outline the tree's crown by sticking pencils into the ground along the outer tips of the tree's branches.
2. Measure the distance between the two pencils that are the farthest apart. Write down that number.
3. Measure the distance between the two pencils that are the closest together but still on opposite sides of the tree. Write down the number.
4. Add the two numbers and divide by two. This new number is the tree's average crown spread.



Total Points

Trees are compared by their total points. To find your tree's total points, add: trunk circumference measurement (in inches), height (in feet), and ¼ of its average crown spread (in feet). This number is the total points for your tree.

$$\text{Circumference} + \text{height} + \frac{\text{crown spread}}{4} = \text{TOTAL POINTS}$$

ACTIVITY 4

What's a Tree Worth?

Concept

Trees have many different values for people and meet many different human needs. The perceived benefits of trees change as people's needs and desires change.

Objectives

Students will identify the different values people place on trees and the different needs trees meet.
Students will understand how the importance of trees has changed over time.

Subjects

Ecology, botany, social studies, economics, fine arts.

Skills

Value clarification, analysis, evaluation, observation.

Prerequisites

None.

Time

Two 40-minute class periods.

Materials

"What We Get From Trees" worksheet • "Tree Evaluation Form"

Background

Trees provide many benefits including:

- Clean water—Trees' hair-like root fibers help filter groundwater, trapping nutrients and pollutants that are potential contaminants.
- Soil protection and nourishment—Tree roots hold soil in place so it cannot be easily blown away by wind or washed water; the decaying of dead tree parts returns nutrients to the soil. Without trees, heavy rains can wash soil into streams and rivers, creating avenues for nutrient pollution and habitat destruction, and increasing the likelihood of flooding.
- Stormwater control—Leaves and branches slow the movement of rain to the ground, allowing it to soak in slowly.
- Air quality—Trees produce oxygen and absorb carbon dioxide. They also capture particulate (dust, pollen, etc.) with their leaves.
- Mineral and nutrient cycling—Throughout their lives trees cycle and utilize minerals and nutrients from the air, water, and soil.
- Habitat for wildlife—Trees and forests provide homes for many different species of animals.
- Aesthetics—Trees beautify urban and community areas such as parks, streets, and schoolyards.
- Recreation and physical health—Forests are great places for activities such as hiking, backpacking, skiing, hunting, and birdwatching. Looking at trees makes people feel better. Studies have shown that hospital patients who can see trees outside their win-

dows tend to recover more quickly than those who look out on pavement and buildings.

- Community spirit—Planting and caring for neighborhood trees can bring residents together to improve their environment and build a sense of community and environmental stewardship.
- Natural source of medicines—Trees provide substances with medicinal value. For example, taxol, a drug extracted from the bark of the yew, is used in treating cancer.
- Education—Forested areas offer many resources as outdoor classrooms, nature centers, and trails.
- Economy—Making room for trees in our cities provides job opportunities and a healthier environment. The forest industry also provides jobs for many people, from cabinetmakers to home builders. Trees planted for energy conservation help consumers save money.
- Energy—Trees are used to shade homes and businesses, keeping them cool and conserving energy. In some parts of the world, trees are the main source of fuel for cooking food, warming homes, and running small businesses.

Procedure

1. Have students create a list of examples of how trees, tree products, and tree-related values are part of their lives. Pass out the "What We Get from Trees" handout (p. 24) and compare their list with the handout.

2. Have students evaluate the tree they adopted in Activity 3 for economic and environmental benefits using the "Tree Evaluation Form." Have students compare their rankings and discuss similarities and differences. Have students include the evaluation form in their journals.

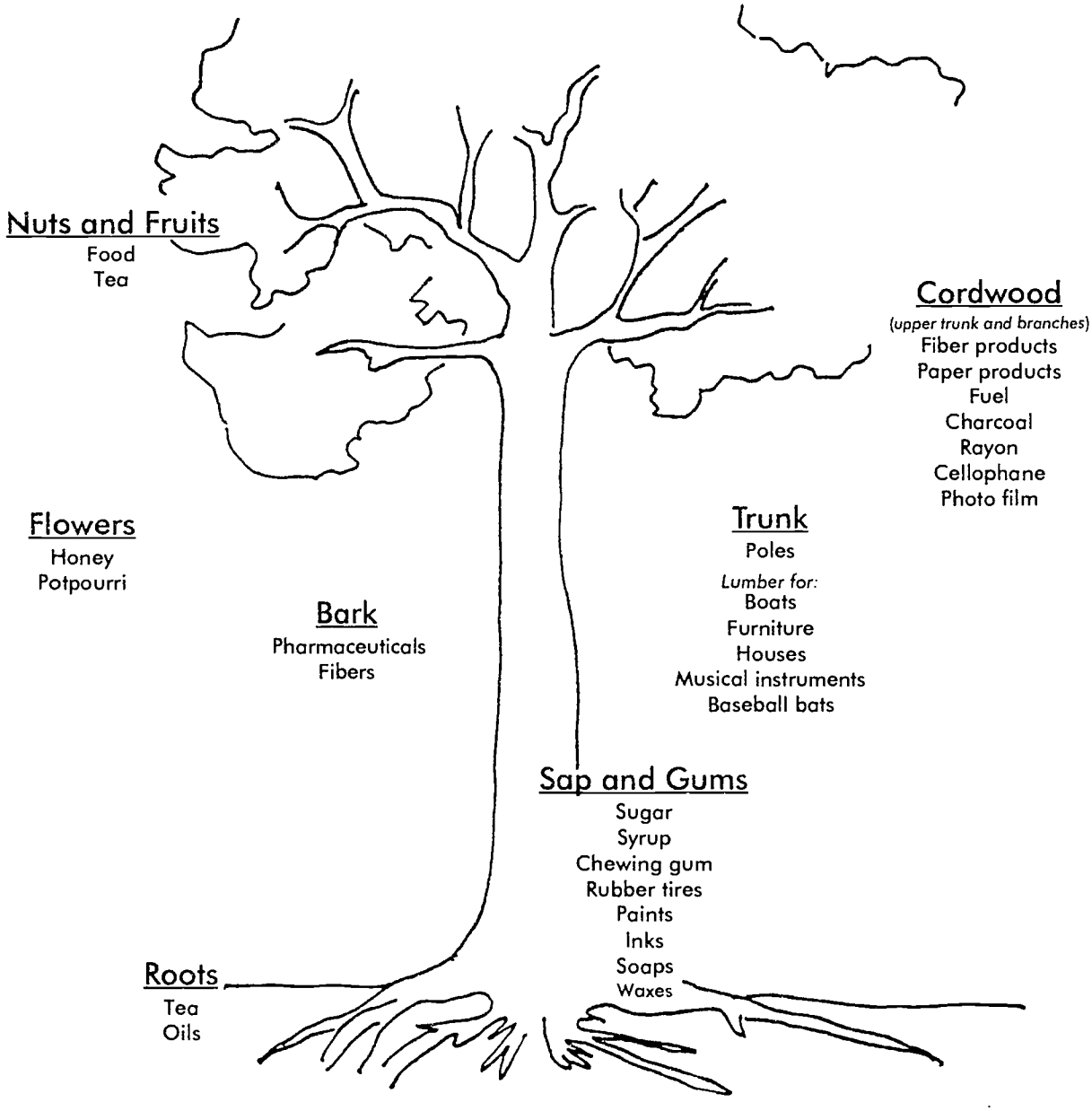
3. Have students discuss the implications for tree planting and tree care of different attitudes towards trees.

4. Provide students with several copies of the worksheet "What We Get from Trees." Choose several important dates in U.S. history—1776, 1865, 1917, and 1952, for example—and have them write one of the years at the top of each page. Have students research and list the benefits of trees for people living at that time.

Discussion

Have students discuss how trees are important to them. How does this compare to the importance of trees to people 100 years ago, 200 years ago, and so on?

What We Get from Trees

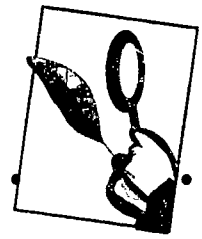


What other products can you think of?

What tree products have you used today?

WORKSHEET

Tree Evaluation Form



INSTRUCTIONS: Evaluate your tree for the following benefits. Rank each benefit from 0 (no value) to 7 (very valuable).

1. **Air Quality:** Wipe the tree's leaves with a damp white cloth. Are the leaves dirty? If so, the tree is cleaning particles from the air.

2 **Floodwater Control:** When it rains, does the ground underneath the tree become wet as quickly as uncovered ground? If not, the tree is slowly absorbing water and breaking up currents, preventing erosion and flooding.

3. **Temperature Control:** Is it cooler under the trees in the summer than in an open area? In the winter, is it warmer under the tree? If so, the tree is moderating temperatures.

4. **Wildlife Habitat:** Are birds, insects, animals, and plants visiting or living in the tree? If so, the tree is providing homes, food, and resting places.

5. **Tree Products:** Do you collect fruit or nuts from the tree? Do you burn fallen branches? Might you cut down the tree to build something with the wood? If so, the tree is providing you with food, fuel, or building materials.

6. **Recreation:** Do you use the tree for playing?

7. **Other:** In what other ways is this tree important to you?

Total Score

How does your tree's score compare with the scores of other trees?

(How to calculate your score: Add the score for each benefit. Divide the total by 7, the number of benefits. The result is your tree value.)

ACTIVITY 5
Nurture a Habitat

Concept

Forest ecosystems provide habitats for many different species. A habitat is the place where an organism lives. Habitat characteristics vary according to the different needs of different species.

Objective

Students will understand habitats as the natural environments in which people, animals, and plants live.

Subjects

Science and geography

Skills

Observation, writing, recording.

Prerequisites

None.

Time

One and one-half class periods, minimum. This activity may be carried out over a school year.

Materials

Small area (a local park, schoolyard, or even a window box or terrarium)
Pen/pencil ● Notebook/journal

Background

A habitat is a place or site where any organism lives. It can be a backyard, a park, or a portion of the school yard. What identifies habitats are the characteristics of individual species that live there. Forests are habitats for trees, other plants, animals, and people. An individual tree may be a habitat for other species.

Procedure

Choose an area and study it as a habitat. Have students make close observations and record them. Students should study the habitat from "the point of view" of the species that live there.

1. What species live there now (animals, plants, insects)?

2. What sources of food, water, and shelter are there for the various species? How does the habitat change at different times of the year?

3. How can the habitat be improved?

4. Make a plan to improve the area as a habitat. What resources and skills are needed? For example, a little

more water may improve the habitat for plants. How might the habitat change with more water? What other resources can be added to change the habitat? Will the changes be beneficial to all the species that rely on the habitat for survival?

Discussion

Have students compare and contrast the habitats they observed in terms of the species living there. When do characteristics overlap? When are habitat characteristics completely different? How do trees "share" habitats with other living things?

The Northern Spotted Owl is a symbol of the controversy over the cutting of old-growth forests in the Pacific Northwest. The owl prefers centuries-old forests because they are the home of its prey—flying squirrels, woodrats, rabbit, and the like. If you had to fend for yourself, you'd want to live near your dinner too!

ACTIVITY 6
The Web of Life

Concept Interdependence means that different organisms rely on one another's existence for survival.

Objective Students will understand that species are interdependent within specific environments.

Subjects Ecology, life science natural history

Skills Observation, communication, hypothesis-testing.

Prerequisites Working knowledge of "habitat" and "ecosystem."

Time At least two 40-minute class periods.

Materials Large ball of twine or yarn • Cards for labeling ecosystem components

Background All life is "interdependent." Understanding interdependency is important for explaining how ecosystems function. It means that different organisms rely on one another for survival. It also explains how different species and populations relate to one another as they evolve, flourish, or become extinct. The relationships that different organisms form with one another define the characteristics of different ecosystems. The physical environment defines the context of their interdependence by providing differing amounts of water, oxygen, minerals, and other elements.

Procedure

1. Divide the class into groups of eight or 10. Have each group of students sit in a circle. Pass out index cards that have been labeled with different components of a forest ecosystem, such as tree, bush, soil, and so on. Include a variety of both living and nonliving components. Begin the activity by listing simple facets of the ecosystem such as soil, water, air, tree, and bird. Each student should hold his/her index card so all the other students in the circle can see which component of the ecosystem he/she is.

2. Give one student the ball of twine or yarn. Have that student hold on to the end of the string and give the ball to another student. The two students are now connected. Have the first student explain how he/she is related to the second student as a "piece" of the ecosystem. If the first student is "rain," he or she may choose to pass the twine along to "soil" because rain keeps soil moist so plants can grow.

3. Continue this process and watch the "web" that appears in the circle. Focus on how the components are connected. Ask the students to explain what would hap-

pen if a piece of the ecosystem were lost.

- Are some components more important than others?
- What might be the long-term effect of an increase or decrease in one of these pieces?
- What happens when people enter the ecosystem and change relationships by:
  channeling water
  planting trees
  introducing new species that have different needs?

Discussion

Have students discuss how the different components of an ecosystem are interdependent. Have them list ways in which they depend on one another at school and within their neighborhoods. Do they have interdependent relationships with trees and forests? How might the trees in their neighborhood affect their lives?

ACTIVITY 7

Do-It-Yourself Forest

Concept Forests are ecosystems, dynamic communities of plants and animals in which trees are the predominant plant species. Forests also are living systems that are constantly changing. As forests change, the character of the ecosystem changes.

Objective Students will be able to identify interdependent components of a forest.

Subjects Life science, ecology, natural history.

Skills Observation, communication, hypothesis-testing.

Prerequisites None.

Time 30 minutes.

Materials None.

Background The interdependence of different species can be defined in terms of nutrient cycles. A nutrient cycle begins with plants that use sunlight, water, and minerals to grow. Some animals eat plants for food; other animals obtain their nutrients by eating meat. When plants and animals die, they decay with the help of microorganisms and insects, returning nutrients to the soil for more plant growth. A nutrient cycle shows how organisms depend on one another for the "fuel" to survive and reproduce.

Nutrient cycles should not be confused with energy flows. Unlike nutrients, energy passes through an ecosystem in a linear fashion. As one organism eats another, energy is converted to heat and then lost. Energy moves through a "food chain" in one direction from one species to another.

Picture a forest, such as a rainforest, or temperate forest. It is constantly changing as its different components change, while nutrients cycle through it.

Here's how one nutrient might move through a forest:

1. The nutrient starts in the soil.
2. A tree takes up the nutrient.
3. An herbivore (plant eater) eats part of the tree.
4. An omnivore (plant and animal eater) eats the herbivore.
5. A carnivore (animal eater) eats the omnivore.
6. The carnivore dies and decays through the action of microorganisms. The nutrient returns to the soil.
7. The cycle starts all over again.

This nutrient cycle is a constantly changing cycle of life and death that keeps the forest alive. The nutrient cycle and the entire ecosystem will be influenced by other events such as increases in rainfall, decreased light, human intrusion, or temperature changes.

Procedure

While this activity is more appropriate for elementary-school children, it can form the basis for activities directed at more advanced grades. The thrust of the activity is to make the students aware of how they are mutually dependent. Any activity that creates a relationship between each of the students in the class can be used to demonstrate the concept of interdependence. Students' understanding of their interdependence can be transferred to other issues, such as changing ecosystems.

1. Clear an open space in the classroom.

2. Assign each student to be a part of the forest ecosystem as outlined in the background section. There should be six groups of students—nutrient, tree, herbivore, omnivore, carnivore, and microorganism.

3. Have students from each group of ecosystem components walk to the cleared area of the room. The six students should stand next to each other, facing in toward what will be the center of a circle. Have six more students—one from each group—join the circle. Keep adding to the circle in sets of six until all the students are in the circle.

4. All students should now be standing shoulder to shoulder, facing inward. Have students join hands.

5. Ask the students to turn to their right, and take one step toward the center of the circle. They should be standing closer together, with each student looking at the back of the head of the student in front of him/her. Remind them they are holding hands because all things in an ecosystem are interrelated. Briefly discuss the idea of interrelationships.

6. Warn students to listen carefully, then have them place their hands on the waist of the person in front of them. Remind the students that by holding hands they were showing that elements of the ecosystem are interrelated. Now they are going to find out that they all are dependent on one another. Have the students sit down—if this works each one should be sitting on the knees of the student behind them.

They may laugh and fall down, but still they will remember the point you are making: Different parts of an ecosystem are related to one another and support one another—their interrelationship and interconnectedness form the ecosystem.

7. Have the students break out of the circle to discuss what an ecosystem is. Briefly discuss interrelations and interdependence in ecological systems.

   If different components of an ecosystem are removed, the ecosystem changes —if change is too extreme, the ecosystem may collapse. Talk with the students about the necessary components of suitable ecosystems and habitats for people, plants, and animals.

8. After the students understand the major point—that at any point in time ecosystem components are interrelated and balanced—have the students try the circle activity again. This time, ask them to hold their positions. Identify a student who represents water. Then say, "It is a drought year. The water supply is reduced by the drought conditions," and have the student who represents "water" remove him/herself from the circle. Watch the circle collapse or adjust itself. You may try several variations of altering the circle—urban sprawl may reduce habitat, pollution of the water supply, soil erosion that decreases food supply.

Discussion

Ask students to talk about what this activity means to them. Ask them to summarize the main ideas they have learned. How must the circle adjust to remain a circle? Does the circle remain—or was the change too great? How does their Living Classroom represent an ecosystem?

ACTIVITY 8

The Amazingly Cool Forest

Concept

Urban trees and forests play an important role in urban energy-use patterns by moderating the urban heat-island effect (when cities retain heat in their roads and buildings, causing their temperatures to rise above the regional temperature).

Objective

Students will learn that city trees reduce the effect of urban heat islands.

Subjects

Math, science, and ecology.

Skills

Analysis, writing, presentation, and calculation.

Prerequisites

None.

Time

Variable. This activity can be adapted for one class period, or designed as an ongoing activity that has students observe and analyze the effect of trees in their communities and neighborhoods.

Materials

"Energy Costs and Benefits" worksheet • "How Cool Is Your Forest?" worksheet
Paper • Pens/pencils • Thermometer • String/tape

Background

Human beings play a critical role in the urban forest. We decide which trees are removed during development and where trees are planted to replace those that have been removed or died. In 1991, AMERICAN FORESTS conducted a survey of 20 major urban forests. It found the average life of a city tree to be 32 years, far shorter than the average life span of a tree growing in a rural forest. The survey also showed that many cities were removing more trees than they planted: On average, for every tree planted, seven died or were cut down. Regular tree care and planting is needed to help improve the life span and condition of urban forests.

The low number of plants and trees in an urban area means there is nothing to absorb carbon dioxide, methane, or carbon monoxide. Dust particles that would be absorbed by plants and trees linger in the air. Without trees and other vegetative cover, soils on hillside slopes can wash away, causing erosion and floods.

Compare the energy needs of people living in the North and the South. People living in the northern United States use more energy for heating and lighting during their long, cold winters. People in the southern United States use more energy for air conditioning during their hot and humid summers. This use of energy combined with the fact that buildings, streets, and other paved surfaces absorb heat from the sun's energy causes urban areas to become "heat islands." Urban areas can average from three to six to 10 degrees warmer than the surrounding countryside and suburbs.

Consuming certain fuels creates the greenhouse effect, which together with the

heat-island effect can markedly influence urban living. The greenhouse effect is a natural process that makes it possible for there to be life on earth. These naturally occurring processes and human activities both emit gases into the atmosphere. These gases act like the glass of a greenhouse, allowing the shorter-wavelength, ultraviolet rays of the sun in, while trapping the long wavelengths of infrared radiation and reflecting them back to earth. The result is an envelope of "greenhouse gases" forming around the earth, trapping heat and warming the planet's lower atmosphere. We need the greenhouse effect to keep the earth's temperature warm enough for us to live, but problems occur when the balance of gases change.

About 80 percent of the "excess" gases come from the burning of fossil fuels, which releases carbon dioxide (CO_2) into the atmosphere. Other gases, including nitrogen oxides (NOx), methane (CH_4) chlorofluorocarbons (CFCs), and ozone (O_3) also contribute to the greenhouse effect.

Two easy ways to reduce energy consumption while improving the environment are tree planting and light-colored surfacing. Properly placed trees will cool a building by shading it and reducing demand for air conditioning. Trees also cool the air by acting as air conditioners through the process of evapotranspiration. As few as three well-placed shade trees around a house can reduce by half the energy demand for heating and cooling for that building. Lightening the color of surfaces maximizes the potential of solar reflectivity and can reduce the amount of energy used for cooling by 30 to 50 percent.

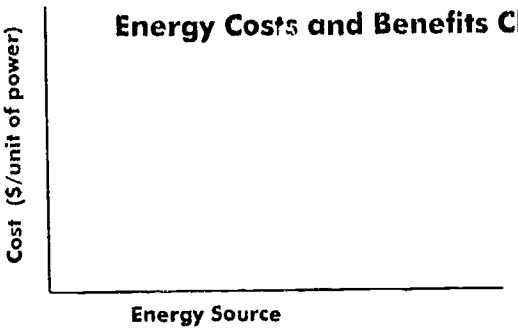
Procedure

Step A

1. Discuss these questions in class:
   - How many different types of energy can you identify?
   - Which of these do you use at home? In school? Elsewhere? How often?
   - What types of fuel does your local power utility use to make energy?

2. Have students individually or in small groups select and research an energy source. Use the Energy Costs and Benefits Worksheet on page 37. Energy sources include solar (passive and active), wind, hydropower, geothermal, natural gas, coal, biomass, nuclear, and hydrogen. The students should research the basics about how their chosen energy source works: Is it currently being used? Is it being considered for future use? What are its by-products (including pollutants)? How cost-effective is it? Is it a renewable or nonrenewable source?

3. Have the class create an Energy Costs and Benefits chart to share the information and compare each energy source.



4. After collecting information have them answer the questions on the Energy Costs and Benefits Worksheet. Then mediate and pose questions for discussion as they debate the advantages and disadvantages of each source. Allow students to refer to the Worksheet throughout the debate.

5. Have students keep an energy diary to identify how they consume energy. Remind them about different heating sources, refrigeration, air conditioners, hot-water heaters, and transportation. In their diaries they should note:
   - The benefits and the costs of their energy usage
   - The ways their energy uses contribute to carbon emission
   - How they can conserve energy
   - How they can reduce carbon emissions
   - What percentage of their household's energy bill is attributable to them

Step B

This portion of the activity is adapted from an energy-use experiment conducted by AMERICAN FORESTS. The experiment is designed to demonstrate how trees can cool a city and influence energy consumption patterns.

1. Discuss these questions in class:
   - Are there different areas in the city that feel warmer or cooler in the summer?
   - Do the different areas experience temperature differences in the winter?
   - What do you think makes different neighborhoods have different temperatures?
   - Do you think having trees and vegetation in a neighborhood influences air temperature?

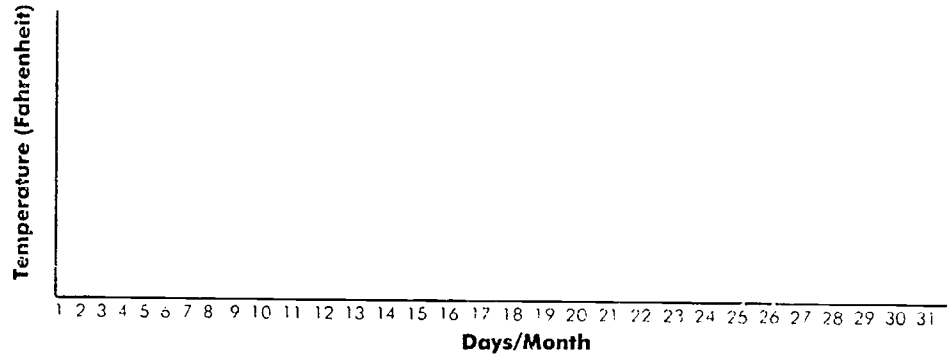
2. Tell students they will test the idea that trees and plants can influence air tempera-

ture. Have students formulate a hypothesis (for example, increased plant and tree cover will cool the air in the hot months while warming the air in the cold months).

3. Using a map of your city, town, or community, have students identify two neighborhoods that will act as test sites. One location should be treeless, the other well-treed.

4. Students should measure the air temperature at the same location and at the same time each day—preferably at mid-day—in each selected neighborhood. Ideally, they should use thermometers that are free standing (on a post, fixed to a fence, or hanging from a tree.) They need to use a maximum/minimum thermometer to record the highest temperature during a 24-hour period. Remember, they are measuring air temperature. If a thermometer is fixed to a building, they will be measuring radiating heat—heat that is reflected off buildings, sidewalks, and streets.

5. Students should measure and chart on graph paper the temperature over time.



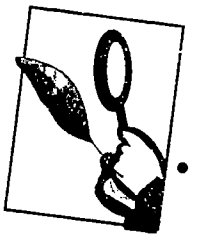
6. Using the information about temperature difference between the two different sites, have students note where to plant trees to maximize energy conservation. The "How Cool Is Your Forest" handout shows basic criteria for strategic tree planting. Note: Variations of ideal plantings will occur with different climates.

Extension

Have students conduct an energy conservation audit of their schoolyard, their neighborhood, or their home. Are trees planted in the right place to maximize energy conservation? Where should trees be planted to maximize energy conservation? How can students create a cool electric forest?

WORKSHEET

Energy Costs and Benefits



1. Name of energy source:

2. Is this an energy source you use every day? If so, how do you use it?

3. How is this energy source harnessed to supply electricity?

4. What by-products and pollutants are emitted when this energy source is used?

5. Are there any environmental costs involved in using the technology needed to harness this energy source?

6. Is the energy source renewable? If so, why and how?

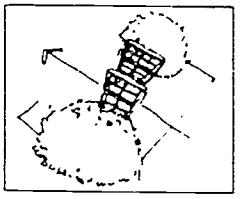
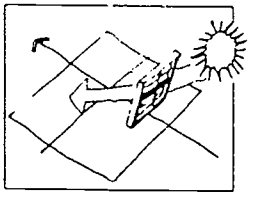
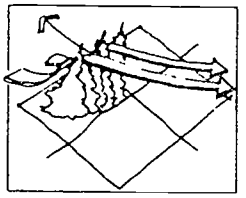
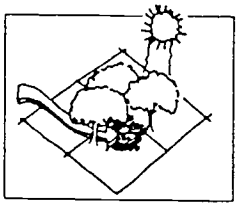
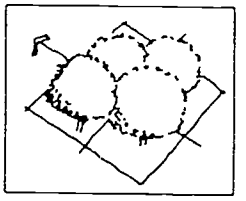
7. Does this technology produce electricity cost-effectively? What do you think is the future of this energy source?

WORKSHEET

How Cool Is Your Forest?

PLANT TREES STRATEGICALLY

Tho Most Critical Actions for Planting for Energy Conservation

	BASIC IDEA	TREE SELECTION CRITERIA	CHECKLIST FOR YOUR FOREST
	shade west and east windows west is best	✓ height ✓ form ✓ density ✓ distance	
	avoid trees to the south of windows let the sun shine in	✓ solar friendly species ✓ shadow length	
	create windbreaks up & over	✓ height ✓ density ✓ spacing	
	shade air conditioners Keep it cool	✓ height ✓ branching height	
	increase canopy cover the more the merrier	✓ max leaf surface area ✓ longevity	

Taken from: Margaret Sand ASLA, "Design and Species Selection to Reduce Urban Heat Island and Conserve Energy", Proceedings of the Sixth National Urban Forestry Conference, AMERICAN FORESTS, (in publication).

43

ACTIVITY 9

Create a Living Classroom

Planning a Living Classroom is an ongoing activity. The classroom will change as new trees are added and the trees grow through their life-cycles. Some trees will die, others will have to be cared for; new animals and plants will be attracted to the site. The history and classroom lessons will change over time. Teachers and students can create new tree stories to fit in with the rhythm of a changing forest.

Concept Humans are the most influential species in the majority of ecosystems.

Objective Students will learn how to shape and manage an ecosystem in a responsible way.

Subjects History, science, geography, horticulture, design, planning.

Skills Planning, analysis, writing, drawing, and presentation.

Prerequisites Previous activities, if possible.

Time This is an ongoing activity for the life of the Living Classroom.

Materials Paper • Pens • "Classroom Design" worksheet • Famous & Historic Trees TreeStories • USDA Planting Zone Map • Tree Selection Guide
For local technical help and advice, contact your city forester, state forester, county Extension agent, or parks department.

Background There are two important reasons to create and maintain Living Classrooms. First, all forests provide important benefits. For people, they clean and cool the air, shade homes and streets, slow stormwater runoff, add beauty, and improve your local ecosystem. For a tree to provide any of these benefits, it must be planted in the right place and be well matched to local soil, climate, and site conditions.

The second reason is unique to your Living Classroom because you choose how you teach about American history through your Famous & Historic Trees. For example, a Living Classroom of trees associated with Patrick Henry, Martin Luther King Jr., and Abraham Lincoln might form the basis of a Human Rights Forest. A Living Classroom that tells the story of America's ever-changing technology might have trees associated with Henry Ford, George Washington Carver, George Eastman, or Cyrus McCormick.

Procedure What follows is only an outline for planning and maintaining a Living Classroom. Use the "Classroom Design" worksheet. Remember: The healthy Living Classroom is one in which the right trees are planted in the right place. For an urban forest, this means planting trees for maximum conservation benefits while remembering to avoid barriers

that may cause problems for trees later on. These include not planting a tall tree under utility lines and not planting a tree where it will conflict with underground utilities or pavement.

1. What themes are common to the trees in your Living Classroom? Can you relate the trees by the people or events they are associated with? Show how they are related like the elements of an ecosystem.

2. Once they have determined the story they want to tell, have the students draw up a Living Classroom plan. Make sure to select appropriate tree species for your climate and site conditions by using the USDA Planting Zone Map (page 41). Each Famous & Historic TreeStory indicates where the trees can be planted in the Habitat section of the "Tree Facts." Students should also use the Tree Selection Guide (pages 48-49) to find what their trees will look like when they are full grown and what growing conditions suit their trees.
   a. What will the Living Classroom look like as the trees grow? Use the Ten Questions To Ask Yourself Before Choosing a Tree portion of the "Classroom Design" worksheet (page 42), along with the Tree Selection Guide to plan tree planting.
   b Have students include animals and other plants in their plan. What in their planned habitat will provide food and shelter for other living things?
   c. Have students determine what resources will be required to maintain the Living Classroom (water, pruning, etc.).
   d. Take photographs of the site as it looks now for future comparison once the site has become a Living Classroom. On their sketch of the Living Classroom, have students draw circles to represent the full-grown tree crowns to determine what the Classroom's canopy cover will be like and how far apart trees should be spaced.

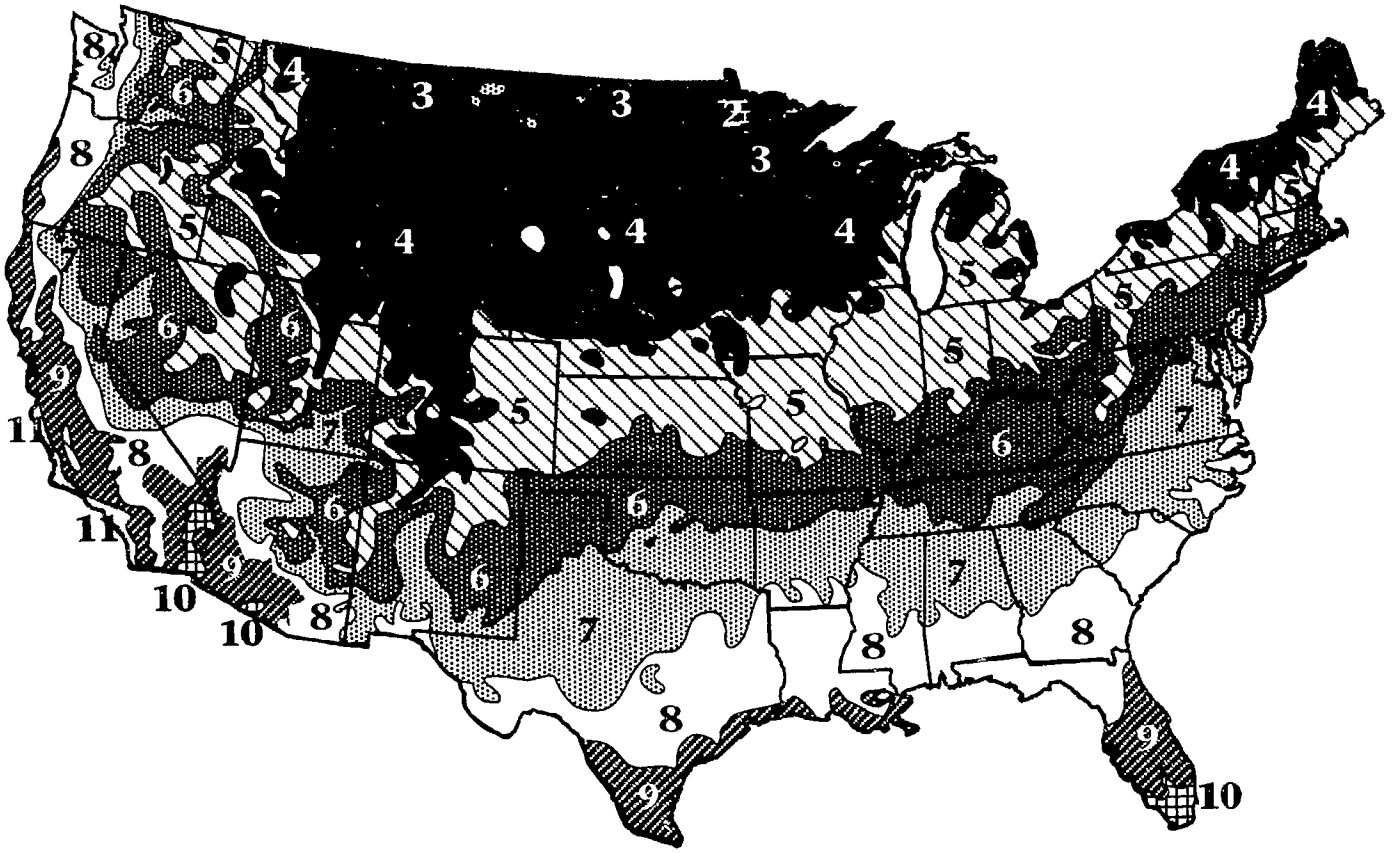
References & Resources

- Harris, Richard W. 1992. *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines.* Englewood Cliffs, NJ: Prentice-Hall.

Discussion

Have students present their plans to their classmates, school, or community for comment. What does everyone want the tree site to look like in five, 10, or 25 years? Will the students' plans achieve the different goals?

Planting Zone Map



KEY *Zone: Planting Times (Average Annual Minimum Temperatures)*

- ZONE 2: Plant from June 1 to September 1 (-50 to -40 degrees)
- ZONE 3: Plant from May 15 to September 1 (-40 to -30 degrees)
- ZONE 4: Plant from May 1 to September 15 (-30 to -20 degrees)
- ZONE 5: Plant from April 15 to September 30 (-20 to -10 degrees)
- ZONE 6: Plant from April 1 to October 30 (-10 to 0 degrees)
- ZONE 7: Plant from March 15 to October 30 (0 to 10 degrees)
- ZONE 8: Plant from February 1 to November 15 (10 to 20 degrees)
- ZONE 9: Plant year-round (20 to 30 degrees)
- ZONE 10: Plant year-round (30 to 40 degrees)
- ZONE 11: Plant year-round (above 40 degrees)

WORKSHEET

Classroom Design

When considering the design of a Living Classroom, consider some of the basic principles used by landscape professionals.

Mass Plantings. Once you locate a good spot for a tree, create a planting bed in which to plant your grove of trees along with shrubs.

Border plantings. Use planting areas to create a border for Living Classroom areas. Consider creating an outdoor laboratory (for raising small plants and flowers).

Complementary Plantings. Placing various-sized shrubs at the bases of trees planted near buildings creates a handsome effect.

Windbreaks and backdrops. Use evergreens for windbreaks or as a backdrop for flowering plants.

What other principles would you use to design your Living Classroom? (These suggestions are from *Growing Greener Cities*, page 46.)

Ten Questions To Ask Yourself Before Planting a Tree

1. What is the purpose of this tree? Will it provide shade, windbreak, fall color, or frame a view?
2. Will it conflict with any overhead wires, underground cables, sewer, gas, or water mains? Call your local utility company before designing your Living Classroom.
3. What will the tree look like when fully grown?
4. How long will it take the tree to reach full size?
5. What are the tree's physical characteristics when mature: Is it tall? Short? Do its leaves fall in the autumn? Does it have flowers in the spring? Will it produce nuts or fruit that will attract animals in the late summer?
6. Will the tree grow well in this location?
7. Is the tree far enough away from any buildings, sidewalks, air-conditioning units, and other trees?
8. Will the tree shade any windows when it reaches full height?
9. How will the tree fit in with other plants, structures, or trees already in the area?
10. What kind of care will the tree need over its lifetime? Who will provide this care? (This list is from *Growing Greener Cities*, page 47.)

What other questions might you ask before planting your trees?

ACTIVITY 10

Planting Your Historic Trees

Concept Specific and individual actions change habitat and ecosystems.

Objectives Students will learn that tree planting makes a positive impact on their environment. Students will learn that making a positive impact through tree planting involves planning and a planting and care process. (Students will learn a practical lesson in responsible behavior.)

Subjects Forestry, civics, horticulture.

Skills Teamwork, tree planting, tree care, research, observation.

Prerequisites Activities 1-8, if possible.

Time Variable. Note: Tree planting is a seasonal activity.

Materials Tree • Shovel • Water • Mulch *(If you use a stake or a tree shelter you will need a hammer. Always have a local forester or local tree-planting group assist with the tree planting.)* • Planting instructions included with each Famous & Historic Tree. "Classroom Design" worksheet

A grove of Famous & Historic Trees planted at a school in Washington, DC, is helping students learn how to make a positive impact on their environment.

Background

Planting a tree and caring for it as it grows is one of the most important actions you can take to improve your environment. Planting trees around your home or school specifically for energy conservation has special significance. Since many of the world's greatest environmental challenges are caused by our energy use, energy-conserving tree planting is a great way to act locally while thinking globally.

Check out the best locations for tree planting. Is there space around your school or home that would benefit from a healthy tree? Activity 9 provides information about planning a tree planting.

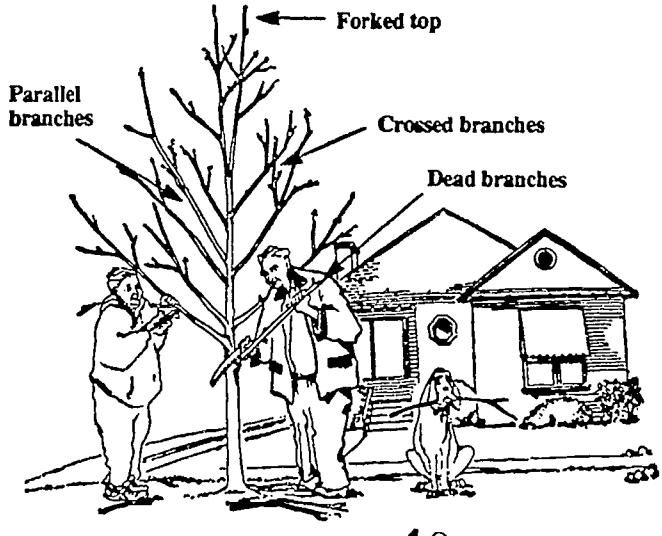
Procedure

Carefully follow the planting instructions that came with your Famous & Historic tree.

Use Classroom Design worksheet on page 42 as a guide to tree planting.

Caring for a tree after it is planted is an important part of making a positive environmental impact. Give the newly planted tree a thorough watering once a week. Don't fertilize during first season unless the soil is especially poor. If necessary, use a slow-release fertilizer. To keep your trees healthy and strong, prune dead or dying branches, crossing branches, or branches that form a tightly angled "V" (see illustration below). Watch for insect and disease problems. Wilting leaves or branches, changes in leaf color, webs, and sticky material on the leaves are signs of these problems. If you see any of these conditions, consult your local cooperative Extension service, or tree-care expert.

Note: Some urban schools are surrounded by concrete and asphalt. Concrete and asphalt must be removed and the soil turned and perhaps amended before trees can be planted. Consult your local forester to be sure. Trees shouldn't be planted in containers, since they will become stressed and stunted (See *Growing Greener Cities*, page 59).



Glossary

Backfill To return soil to a planting area from which it was originally dug.

Bare-root A tree ready for transplanting that has had the soil removed from around its roots.

Biomass All the organic matter created in an ecosystem—all the wood, plants, crops, animal residue.

Cambium The narrow layer of cells between the bark and the sapwood. Cambium is the layer that produces new bark and new wood.

Canopy The cover of branches and foliage formed by tree crowns.

Carbon dioxide (CO_2) A colorless, odorless, non-combustible gas. Humans and all other living organisms give off carbon dioxide in respiration and decomposition. Trees and other plants absorb it and use it during photosynthesis. Also emitted as a by-product of burning fossil fuels.

Conifer Cone-bearing, evergreen tree with needle-like, linear, or scale-like leaves. Found in temperate climate zones, it is the most common tree in colder regions.

Conservation The planning and management of resources to ensure continued access to these resources while maintaining their quality.

Crown The branches and foliage of a tree. Crown spread is the area covered by the branches and foliage of a tree.

Deciduous Trees that shed their leaves regularly. They may be cold-deciduous, dropping their leaves when the weather becomes cool (as in autumn) or drought-deciduous, dropping their leaves when the water supply is low.

Deforestation The removal of trees and often plants associated with them.

Evapotranspiration The process by which plants lose water from their leaves. Provides cooling.

Food chain The plants and animals through which energy flows. Plants make up the base of the chain by converting energy from the sun into food. Animals comprise the next steps in the chain by eating plants or other animals to get energy.

Greenway Green open space that stretches into cities and settled areas, often following waterways or abandoned railway lines.

Heartwood The central part of the tree's stem, or trunk, it provides support. No longer contains any live cells. Also called sapwood or xylem.

Increment borer A tool used to extract a core of wood from a tree. Using this technique, the age and condition of trees can be determined without destroying the tree. This tool should be used only by professionals because it can allow insects and disease to enter the tree, especially in urban areas.

Interdependence Mutual dependence.

Leaf bud A bud from which only leaves and stems develop.

Lobes The divisions in leaves. For example, red maple leaves have five lobes.

Mulch A protective organic covering placed around plants to keep in moisture and prevent the growth of weeds.

Phloem The layer of cells that transports nutrients from the crown to the roots. Also called inner bark.

Photosynthesis The process by which energy from the sun is converted into food by plants. Light energy, carbon dioxide, and water are combined to form sugar and oxygen.

Renewable A resource that is of unlimited quantity and can be used indefinitely.

Riparian corridor The area adjacent to and alongside a waterway, stream, or lake.

Rootball The clump of soil containing the roots of a tree, often bound in burlap.

Roots The underground part of the tree; they anchor the tree and absorb water and nutrients.

Sapling A young tree that measures two to four inches in diameter.

Sapwood The pale-colored living wood next to the bark. It is formed from the cambium and conducts water and minerals from the roots to the leaves. Also called xylem or heartwood.

Seedling	A young tree that has recently sprouted from a seed.
Sidewalk pit	Small preserves of soil found in urban centers, usually within sidewalks. These pits are often the only places to plant trees in these areas, and constitute a sort of immovable "street planter."
Silviculture	The art and science of growing and harvesting forest products.
Treelawn	The usually narrow area between the curb and the sidewalk.
Trunk	The main stem of a tree.
Urban forest	Created where people congregate and build communities. Since humans are the main inhabitants of the urban forest, they largely determine the tree species found there.
Well-aerated soil	Soil that has been loosened enough so that at least 50 percent of its volume is air.
Well-developed soil	Soil sufficiently weathered to have readily identifiable layers, or "horizons." An organic layer is at the top; the mineral layer is close to the bottom.
Whip	A young tree. Often one that has developed a main stem but very few branches.
Xylem	The layer of cells that transport water and nutrients to the leaves and branches from the roots. Also called heartwood or sapwood.

These tree profiles show the mature shape of many of the species in the chart below. Match the profile number with the tree number on the chart to see how your tree will be shaped. (Not all trees are shown)

Tree Profiles 

Tree Selection Guide

	Flower	Fall Color	Foliage	Hedge	Poor Soil	Alkaline	Wet	Dry	Hi Heat	Height	Spread	Growth
1. Apple *Malus*	❀	❖	❦							20	15	M
2. Ash, Green/White *Franxius pennsylvanica/americana*		❖			■	✓	●	○		70	50	F
3. Birch, Paper *Betula papryfera*		❖					●			35	20	M
4. Birch, River *Betula nigra*		❖					●			30	20	M
5. Birch, White/Black *Betula*		❖					●			45	25	M
6. Boxelder *Acer negundo*					■	✓	●	○		60	40	F
7. Buckeye, Ohio *Aesculus glabra*	❀									40	20	M
8. Buckthorne, Common *Rhamnus cathartica*				×	■		●	○		20	15	F
9. Catalpa *Catalpa speciosa*	❀		❦		■	✓	●	☽		50	30	M-F
10. Cedar, Red *Juniperus virginiana*				×	■	✓		○	▲	30	20	M-F
11. Cedar, White *Thuja occidentalis*				×	■	✓		☽		40	20	S-M
12. Chaste Tree *Vitex agnus-castus*	❀			×	■	✓		○		15	15	F
13. Cherry, Japanese *Prunus serrulata*	❀									30	25	F
14. Chestnut, American *Castanea dentata*		❖	❦		■		●			35	30	M
15. Chinaberry *Melia azedarach*					■	✓		☽		30	30	F
16. Coffeetree, Kentucky *Gymnocladus dioica*					■	✓		○		60	30	M
17. Cottonwood, Eastern *Populus deltoides*		❖	❦		■	✓	●	☽		90	50	F
18. Crabapple *Malus spp.*	❀	❖								20	20	M-F
19. Crapemyrtle *Lagerstroemia indica*	❀	❖			■	✓		☽		25	15	S-M
20. Cypress, Bald *Taxodium distichum*					■	✓			▲	60	30	M
21. Elm, Siberian *Ulmus pumila*					■	✓	●	☽		25	20	F
22. Elm, Winged *Ulmus alata*					■	✓	●	○		40	30	F
23. Franklinia *Franklinia alatamaha*	❀	❖					●			15	10	S-M
24. Goldenrain *Koelreuteria bipinnata*	❀				■	✓		○		30	30	M-F
25. Hackberry *Celtis occidentalis*					■	✓	●	☽		50	40	M
26. Holly, American *Ilex opaca*			❦	×						25	20	S-M
27. Honeylocust *Gleditsia triacanthos*					■	✓		☽		40	25	M
28. Honeysuckle, Tatrian *Lonicera tatarica*	❀			×	■	✓		○	▲	8	8	F
29. Locust, Black *Robinia pseudoacacia*	❀				■	✓		☽		40	25	F
30. Magnolia, Southern *Magnolia grandiflora*	❀		❦				●	○		50	40	S-M

❀ **Flower**(*Flowering*) Flowers provide a noticeable landscape effect. ❖ **Fall Color**(*Foll color*) In most areas fall color is distinct and showy.
❦ **Foliage**(*Unusual foliage*) Contrasts with other plants due to color, texture, or size. × **Hedge**(*Hedge or screen*) Effective in screening views or creating hedges.
■ **Poor Soil**(*Poor Soils*) Tolerates poor soils. ✓ **Alkaline**(*Alkaline soils*) Tolerates alkaline or basic soil conditions.

	Flower	Fall Color	Foliage	Hedge	Poor Soil	Alkaline	Wet	Dry	Hi Heat	Height	Spread	Growth
31. Maple, Red *Acer rubrum*		❖					●			40	30	M
32. Maple, Silver *Acer saccharinum*		❖			■	✓	●	○		40	30	F
33. Mimosa *Albizia julibrissin*	❀				■	✓		☽	▲	30	30	F
34. Oak, Bur *Quercus macrocarpa*					■	✓		○		60	30	S-M
35. Oak, Chestnut *Quercus prinus*		❖					●			60	35	M
36. Oak, Chinkapin *Quercus muehlenbergi*		❖			■	✓		○		30	20	S-M
37. Oak, English *Quercus robur*			❦							60	30	M
38. Oak, Laurel *Quercus laurifolia*					■		●	○		70	50	M
39. Oak, Live *Quercus virginiana*					■			☽		50	75	S-M
40. Oak, Overcup *Quercus lyrata*		❖					●			60	35	M-F
41. Oak, Red *Quercus rubra (Northern) falcata (Southern)*		❖				✓				80	60	M-F
42. Oak, Pin *Quercus palustrus*		❖					●			80	40	M
43. Oak, Swamp *White Quercus bicolor*			❦				●			90	40	S-M
44. Oak, Water *Quercus nigra*						✓		○		60	40	F
45. Oak, White *Quercus alba*			❦							70	50	S-M
46. Oak, Willow *Quercus phellos*			❦				●			70	40	M
47. Oleander *Nerium oleander*	❀			×	■	✓	●	☽	▲	12	10	F
48. Osage Orange *Maclura pomifera*		❖			■	✓		○		50	30	F
49. Pecan *Carya illinoiensis*		❖			■					60	40	S-M
50. Persimmon, Common *Diospyros virginana*		❖			■	✓		○		35	20	M-F
51. Pine, Longleaf *Pinus palustris*				×	■		●	☽		60	30	M-F
52. Pine, White *Pinus strobus*				×	■		●	○		80	V	M-F
53. Poplar, Tulip *Liriodendron tulipifera*		❖					●			50	30	F
54. Redbud, Eastern *Cercis canadensis*	❀				■	✓		○		20	15	M
55. Scholar, Chinese *Sophora japonica*					■					40	20	F
56. Sweetgum *Liquidambar styraciflua*		❖					●			60	30	F
57. Sycamore *Plantanus occidentalis*					■	✓	●	☽		75	40	F
58. Walnut, Black *Juglans nigra*					■	✓		○		60	45	S
59. Willow, Weeping *Salix babylonica*					■		●			35	25	F
60. Wisteria *Wisteria floribunda*	❀									30	V	F

●**Wet**(*Wet sites)* Tolerant of wet or poorly drained soils. ☽**Dry**(*Drought)* Drought-tolerant.
▲**Hi Heat**(*High heat)* Tolerant of high heat, reflected light, or other abnormal temperature conditions. **Height**(*In feet)* Average mature height of tree.
Spread(*In feet)* Size of crown at maturity. P=Pyramid V=Variable **Growth**(*Growth rate)* S=Slow M=Moderate F=Fast

Notes

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PEOPLE CARING FOR TREES AND FORESTS SINCE 1875